

Muscle Relaxants

Their Use and Abuse in Anesthesia

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LUMBAR PUNCTURE AND VENIPUNCTURE have long been considered simple procedures easily within the abilities of most interns. A corollary to this "axiom" is that interns may be permitted to take and do readily accept the responsibility of giving anesthetic agents intraspinally and intravenously.

Recent criticism of spinal anesthesia and wide publicity given to a relatively few complications with subarachnoid block have taken this method out of the hands of the untrained and inexperienced.

Partly because of this decline in popularity of spinal anesthesia, partly because of the increased popularity of the Bovie electrosurgical unit, but mostly because it is so easily given and so pleasantly received, intravenous anesthesia has waxed steadily in esteem not only in medical but in nonprofessional quarters as well.

When the ultra-short acting barbiturates were finally effectively developed, they were rapidly accepted. The wise addition of oxygen and nitrous oxide mixtures helped to maintain them in general use, but it was the introduction of d-tubocurarine that truly established the place of this method in medical practice. The intermittent injection of small increments of narcotics throughout the anesthetic period completed the technique.

There is no question that this barbiturate-relaxant-inhalant-narcotic combination has become in the short space of fifteen years the predominant method of anesthesia in the United States. It is a valuable, reliable, precise orderly technique with almost too broad applicability. Without the relaxants, the technique would have certainly a much smaller—although not minor—role in contemporary anesthesia. With curare and the other relaxants it has become famous—and infamous.¹

There may be profit in exploring some of the reasons for infamy. That "curare" is *per se* responsible for the large number of so-called "anesthetic deaths" attributed to it is impossible to believe. This is not to deny that there have been a number of "curare deaths," but some investigators believe that it is possible there were mistakes in technique

• Probably the most widely used anesthetic today is the intravenous-inhalant-relaxant combination. The relaxant drugs are the key to this combination. Lack of knowledge of the pharmacology of these drugs, their effect on circulation and respiration and of the physiology of respiration can seriously abuse and impair the evident value of this method. It should not be used routinely to the exclusion of equally valuable techniques that might serve better in some circumstances.

or judgment by the anesthetists in some cases. In addition it is possible there have been many other errors of commission or omission which were not fatal or perhaps even debilitating. Hence it is well to give attention to some of the things that may have been done that should not have been done and to things that should have been done but may have been neglected.

To begin with, the successful use of the whole technique requires more knowledge and ability than that needed for successful venipuncture. And even the ability to do venipuncture acceptably is not shared by all the votaries of this method of anesthesia. There are a few simple principles, the mastery of which should be required of anyone planning to administer drugs intravenously.

A fact often overlooked is that once these drugs are injected they are irrecoverable. In the main, metabolic processes must be relied upon for their detoxification or elimination. If plasma pseudocholinesterase is abnormally low, as it might be in patients who have been bleeding profusely, or who have been exposed to certain agricultural poisons, the recovery from succinylcholine injection may be very prolonged. Edrophonium should be used to counteract d-tubocurarine, but it must be remembered that it is a short acting drug and sometimes unreliable, especially when dealing with relatively large doses of curare.

This of course means that the drug and dosage must be chosen to fit the individual case. Yet a timid approach with repeated small doses is undesirable, for one can get into trouble easier with too little curare than with too much.

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The relaxants are divided generally into two types: (a) Those causing muscular paralysis by preventing depolarization of the motor end plate by a nerve impulse and (b) those preventing repolarization after the impulse has been discharged. In general, the former are slower of onset, longer of action and less rapidly eliminated. They can be antagonized to some degree by prostigmine and its homologues. Of these, d-tubocurarine is the most useful. The methylated curares, although effective in small dosage, have no real advantage. Gallamine triethiodide is reputed to be less toxic than d-tubocurarine, is readily eliminated in the urine, has no histamine action (although the author has never been much impressed with this feature of d-tubocurarine) and does not cause autonomic blockade or vascular collapse. It is perhaps easier to intubate when Flaxedil® rather than d-tubocurarine is used. But gallamine does increase secretions and it causes tachycardia which can be confusing.

Decamethonium and succinylcholine, the depolarizing agents, are quickly effective and rapidly eliminated, and therein lies their chief advantage. Both are used in combination with d-tubocurarine. However, experience has shown that the administration of decamethonium and d-tubocurarine together, at least in very ill "toxic" patients, may cause persistent and consequently fatal apnea.

Decamethonium is the ideal agent for use when relaxation for intubation only is desired or where periods of 15 minutes or less of relaxation are required. But beyond this, it has little value.

Since succinylcholine is actually a pharmacologic antagonist to d-tubocurarine, the use of these two together is technically illogical. However, from a practical clinical standpoint, they can be used together even in the same syringe. Preferable practice is to use succinylcholine throughout as a drip or to use d-tubocurarine after the initial dose of succinylcholine has been destroyed.

When succinylcholine is used as an aid for intubation of patients having operations about the head and neck, it is common for a patient to complain afterward that "someone sat on my chest" or "kicked me in the belly" during the operation. This phenomenon is apparently secondary to the muscular fasciculation observed after the injection and is, to the author at least, a very real limitation upon its use.

These drugs, although acid in reaction, can be mixed with alkaline pentothal solutions in so-called Baird's or Clark's mixtures. The purpose of this combination is to reduce the required dose of thiopental and consequently lessen postoperative depression. In many cases it serves that purpose, but often an overdose of one drug must be given to get the desired effect of the other. Therefore, it is better to

use separate syringes and give the calculated dose of each drug rather than predetermined routine combinations.

Many physicians use curare as an analgesic in spite of the fact that very early it was determined that it has no analgesic properties.² Differentiation must always be made between the need for additional muscular relaxation and additional anesthesia. The relaxants should be used for one and the narcotics for the other, but not the relaxants for both. It is possible to so relax a patient that he cannot complain of pain, but to do so constitutes abuse of a valuable drug.

Relaxants are just what the name implies. Respiratory muscles have the fortunate quality of being most resistant to the effects of curare and similar compounds. But some degree of interference with respiration must always be assumed when this combination of drugs is used in clinical anesthesia. They are all respiratory depressants excepting nitrous oxide. If ether is used, it of course acts synergistically with curare.

Too often ventilation is inadequate either because of ignorance or carelessness on the part of the anesthetist. Simply placing the patient in an oxygen-rich atmosphere does not insure a high arterial pO_2 . And when ventilation is insufficient to maintain normal arterial tension, there is also insufficient carbon dioxide elimination. And there it is—hypoxia plus hypercarbia equals asphyxia.

On the other hand, overly vigorous, constant "bagging" of the patient can be almost as deleterious either by filling the stomach with air or interfering with circulation.

Furthermore, an endotracheal tube must not be looked upon as the whole solution for this problem. While it is perhaps the most valuable tool in anesthesia, after all, sore throat, dental injury, cut lips, nasal hemorrhage and laryngeal granulomas do sometimes result from use of the tube.

The partial autonomic blockade produced by d-tubocurarine can be a desirable effect, but also it can result in a fall in blood pressure. Hypotension following induction of anesthesia with curare and thiopental is not uncommon, especially if rapid intubation is accomplished. Probably in the majority of patients this is of no consequence; but in a certain few, particularly debilitated or chronically ill elderly patients, it can be fatal.

During the past two decades the rapid evolution of the practice of anesthesia, amounting almost to a revolution, has brought about so many changes that now it seems desirable to speak of the practitioners of this art as anesthesiologists. An anesthesiologist may be described as a practicing physiologist and pharmacologist. Unless he knows well the effects and uses of the relaxant drugs, he is not entitled to

use either the appellation for himself or the drugs in his practice.

Also, one who calls himself anesthesiologist should be master of all techniques used for the production of anesthesia and analgesia. His choice of method and agent should be dictated by all factors operative in any given case and should not be limited by personal preference stemming from lack of knowledge or absence of skill with an alternative technique. All too often, through habit, carelessness, mental stagnation or trepidation, a method or a particular anesthetic agent—cyclopropane or ether, for instance—is not used even though it may be distinctly indicated in a given case.

To be sure, in the majority of cases the balanced intravenous-inhalant-relaxant method serves well if

the limitations of the method in general and of the individual drugs in particular are constantly kept in mind. But in many instances it will not serve adequately, and failure then to select the agent and method that is indicated is just as much abuse of the relaxants as is improper dosage or inadequate support of the patient.

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